

Advanced Rotor Coils for Conduction Cooled Superconducting Multi-Megawatt Motors for Aircraft Propulsion, Phase I

Completed Technology Project (2018 - 2019)



Project Introduction

Future Turboelectric or Hybrid Electric aircraft requires high power density and efficiency power generation components for which superconductors are likely key enablers. Therefore, there is a need for light-weight, high-performance superconducting wire with sufficiently high operating temperature. There has been stated interest in using high temperature superconductors (HTS) such as rare earth barium copper oxide (ReBCO) for motors and generators because of many desirable characteristics, including high critical currents, low transient losses, low sensitivity to strain degradation effects and its high critical temperature, which enables the superconducting application to be cooled with a relatively inexpensive and abundant cryogen such as liquid nitrogen.

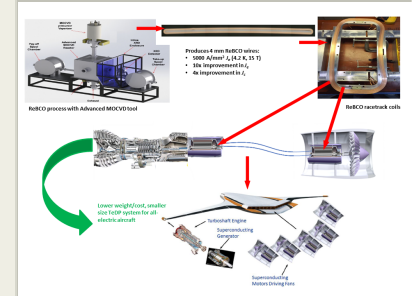
NASA currently has active projects for designing superconducting rotors using commercially available ReBCO coated conductor. Researchers have recently made significant improvements in the superconductivity of ReBCO coated conductor through advanced metal organic chemical vapor deposition (MOCVD) processes with reported engineering current densities an order of magnitude greater than commercial wire. This demonstrated 10x enhancement in performance will enable higher current carrying capability for the same coated conductor cross section, or equivalently reduce the required amount of tape by approximately 80-90%, thereby significantly reducing the cost of superconducting motor projects at NASA, and likewise, components in a TeDP system.

This proposed Phase I proposal focuses on: 1) verifying and demonstrating the improved superconductivity properties of the ReBCO made from the advanced MOCVD process in tape and coil form, including bend tests, and 2) explore potential coil designs with various insulation options that will improve temperature uniformity and quench detection for full size rotor coils demonstrated in a Phase II effort and for rotor coils developed for future turbo-electric aircraft motor/generators.

Anticipated Benefits

Aircraft power components (motors, generators, cables), transformers, inductors, power conditioning equipment, land-based generators and motors, actuators, MHD magnets, propulsion engines and other applications where light weight power components are required.

Superconducting transformers, motors, generators, fault current limiters, DC transmission cables, 4 to 20 MW wind and wave turbine generators, aircraft turbo-generators, offshore oil platform motors, marine propulsion and generation systems, portable emergency power systems, fusion magnets, high energy physics and nuclear physics field-shaping coils for accelerators, and superconducting magnetic energy storage (SMES).



Advanced Rotor Coils for Conduction Cooled Superconducting Multi-Megawatt Motors for Aircraft Propulsion, Phase I

Table of Contents

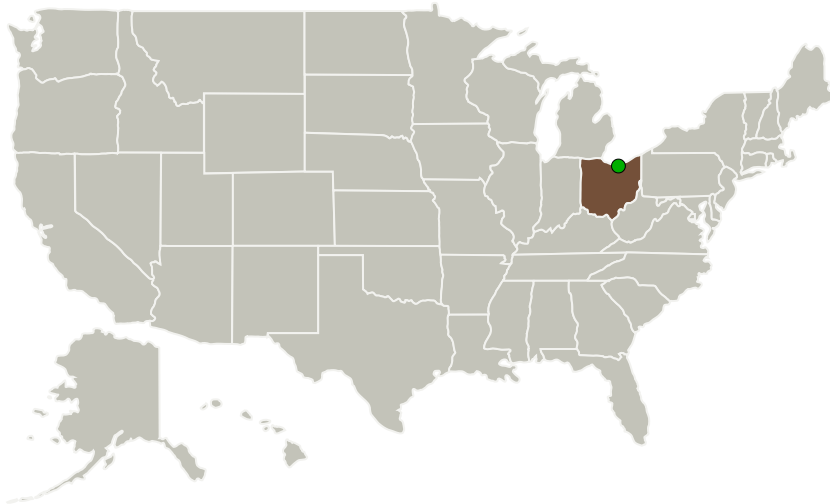
Project Introduction	1
Anticipated Benefits	1
Primary U.S. Work Locations and Key Partners	2
Project Transitions	2
Organizational Responsibility	2
Project Management	2
Technology Maturity (TRL)	2
Images	3
Technology Areas	3
Target Destination	3

Advanced Rotor Coils for Conduction Cooled Superconducting Multi-Megawatt Motors for Aircraft Propulsion, Phase I

Completed Technology Project (2018 - 2019)



Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Hyper Tech Research, Inc.	Lead Organization	Industry	Columbus, Ohio
● Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations

Ohio

Project Transitions

**July 2018:** Project Start**February 2019:** Closed out**Closeout Documentation:**

- Final Summary Chart(<https://techport.nasa.gov/file/140915>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Hyper Tech Research, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

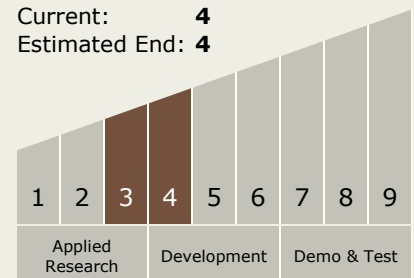
Carlos Torrez

Principal Investigator:

Matthew Rindfleisch

Technology Maturity (TRL)

Start: **3**
 Current: **4**
 Estimated End: **4**

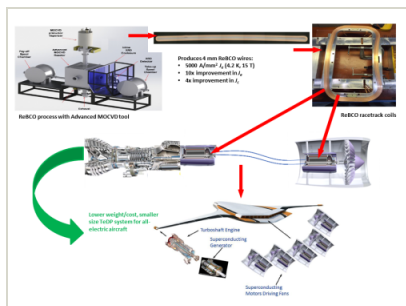


Advanced Rotor Coils for Conduction Cooled Superconducting Multi-Megawatt Motors for Aircraft Propulsion, Phase I

Completed Technology Project (2018 - 2019)



Images



Briefing Chart Image

Advanced Rotor Coils for
Conduction Cooled Superconducting
Multi-Megawatt Motors for Aircraft
Propulsion, Phase I
(<https://techport.nasa.gov/image/128010>)

Technology Areas

Primary:

- TX01 Propulsion Systems
 - └ TX01.3 Aero Propulsion
 - └ TX01.3.1 Integrated Systems and Ancillary Technologies

Target Destination

Earth